CLAIMS

What is claimed is:

1. A FAX-through data network apparatus configured to transmit a FAX communication from a sender FAX machine to a receiver FAX machine without routing a signal through a PSTN, comprising:

a receiver side LAN end station having a receiver IP address;

a sender side LAN end station having a sender IP address;

a first converter configured to receive the FAX communication from the sender FAX machine and convert the FAX communication to a network packet format to generate a FAX packet including a FAX-network ID for the receiver FAX machine;

a FAX-network server configured to receive the FAX packet, extract the FAX-network ID, look up the an IP address associated with the FAX-network ID in a mapping table, and forward the FAX packet to the IP address found in the mapping table; and

a second converter configured to intercept and identify the FAX packet, extract the FAX communication from the FAX packet, establish a communication link with the receiver FAX machine without routing a signal through the PSTN, and transmit the FAX communication to the receiver FAX machine.

2. The apparatus of claim 1, wherein the FAX packet includes a FAX network type field that identifies the FAX packet as either a FAX data packet or a FAX notification packet.

3. The apparatus of claim 1, wherein the FAX-network ID has a format similar to a PSTN number.

4. The apparatus of claim 2, wherein the FAX data packet contains data representing the FAX communication.

5. The apparatus of claim 2, wherein the FAX notification packet contains the FAX-network ID and an IP address associated with the FAX-network ID.

6. The apparatus of claim 1, wherein the first converter is comprised of:

a FAX transmit buffer configured to store the FAX communication received from the sender FAX via a FAX communication port, wherein the FAX communication port establishes a communication with the sender FAX machine without routing a signal through the PSTN;

a FAX to network package unit configured to receive the FAX communication and convert the FAX communication to the network packet format to generate the FAX packet; and

a transmit channel arbitrator configured to monitor a sender side end station transmit channel, such that the FAX packet is transferred to the FAX-network server via a transmit channel of a LAN communication port.

7. The apparatus of claim 6, wherein the transmit channel arbitrator includes logic that directs the transfer the FAX packet when the transmit channel is idle.

8. The apparatus of claim 6, wherein the transmit channel arbitrator includes a latency control module that monitors the transmit buffer for priority status data, and upon detecting priority status data in the transmit buffer, preempts the transmit channel and makes the transmit channel available for high priority transmission.

9. The apparatus of claim 6, wherein the transmit channel is reserved for the duration of the high priority data transmission.

10. The apparatus of claim 6, wherein the first converter includes a mapping table containing at least one entry associating a FAX-network ID with an IP address, the first converter configured to search the mapping table using the receiver FAX-network ID as a key and, if a matching IP address is found in the mapping table, to insert the found IP address into the FAX packet and send the FAX packet to the second converter without routing it through the FAX-network server.

11. The apparatus of claim 6, wherein the sender FAX machine also receives FAX communications, such that the first converter is further comprised of:

a source IP extractor configured to detect the sender IP address by monitoring packets transmitted by the sender side LAN end station to generate a notification packet including a FAX network packet type field, the sender FAX-network ID and the sender IP address;

wherein the transmit channel arbitrator is further configured to monitor the sender side end station transmit channel, and transmit the notification packet/FAX packet to the FAX-network server via the transmit channel of the LAN communication port;

a receive channel filter configured to monitor packets transmitted to the sender side LAN end station in order to identify and intercept the FAX packet;

a FAX receive buffer configured to store the FAX packet; and

a network format to FAX format unpack unit configured to extract the FAX communication from the FAX packet and forward the FAX communication to the sender FAX machine via the FAX communication port, such that the FAX communication port establishes a communication with the sender FAX machine without routing a signal through the PSTN.

12. The apparatus of claim 11, wherein the FAX-network server is comprised of:

an input filter configured to receive a network packet and identify a notification packet and a FAX data packet based on the network packet type field;

a first extractor configured to determine the destination FAX-network ID from the FAX packet;

a FAX-network server mapping table containing at least one entry associating a FAX-network ID with an IP address;

a search engine configured to determine the destination FAX IP address from the FAX-network mapping table using the destination FAX-network ID as a key; and

a packet modifier configured to replace a destination IP address of the FAX packet with the destination FAX IP address and a source IP address of the FAX packet with a FAX-network server IP address.

13. The apparatus of claim 12, further comprising a second extractor configured to determine a FAX-network ID and an IP address contained in the notification packet to create a new entry in the FAX-network server mapping table.

14. The apparatus of claim 12, wherein the FAX-network server is local to the sender side LAN end station.

15. The apparatus of claim 14, further including a remotely located FAX-network server, the remotely located FAX-network server in communication with the local FAX-network server via a public computer network, the remotely located FAX-network server including a mapping table containing at least one FAX-network ID and an IP address associated with the FAX-network ID, such that the local FAX-network server can query the remotely located FAX-network server using

a FAX-network ID as a key and the remotely located FAX-network server can return an IP address associated with the FAX-network ID used as a key.

16. The apparatus of claim 15, wherein additional levels of FAX-network servers containing mapping tables are in communication with the local FAX-network server and the remotely located FAX-network server to provide query/resolution of FAX-network ID and associated IP address information.

17. The apparatus of claim 15, wherein mapping table update information providing FAX-network ID and associated IP address information is shared between the local FAX-network server and the remotely located FAX-network server.

18. The apparatus of claim 1, wherein the second converter is comprised of:

a source IP extractor configured to detect the receiver IP address by monitoring packets transmitted by the receiver side LAN end station to generate a notification packet including the receiver FAX-network ID and the receiver IP address;

a transmit channel arbitrator configured to monitor a receiver side end station transmit channel and transfer the notification packet to the FAX-network server via a transmit channel of a LAN communication port;

a receive channel filter configured to monitor packets transmitted to the receiver side LAN end station in order to identify and intercept the FAX packet;

a FAX receive buffer configured to store the FAX packet; and

a network format to FAX format unpack unit configured to extract the FAX communication from the FAX packet and forward the FAX communication to the receiver FAX machine via a FAX communication port, such that the FAX communication port establishes the communication with the receiver FAX machine without routing a signal through the PSTN.

19. The apparatus of claim 18, wherein the receiver FAX machine also transmits FAX communications, such that the second converter is further comprised of:

a FAX transmit buffer configured to store the FAX communication received from the receiver FAX via a FAX communication port, wherein the FAX communication port establishes a communication with the receiver FAX machine without routing a signal through the PSTN;

a FAX to network package unit configured to receive the FAX communication and convert the FAX communication to generate the FAX data packet including the destination FAX-network ID; and

a startup switch configured to receive the notification packet and the FAX data packet, such that once the notification packet is transferred to an output of the startup switch, the FAX data packet is transferred to the output thereafter,

wherein the transmit channel arbitrator is further configured to monitor a receiver side end station transmit channel, and transfer the notification packet/FAX packet to the FAX-network server via the transmit channel of the LAN communication port.

20. The apparatus of claim 1, wherein the FAX-through data network is further configured to transmit a FAX communication from the receiver FAX machine to the sender FAX machine without routing a signal through a PSTN, further comprising:

a first converter configured to receive the FAX communication from the receiver FAX and convert the FAX communication to generate the FAX data packet including a sender FAX-network ID; and

a second converter configured to intercept and identify the FAX data packet, extract the FAX communication from the FAX data packet, establish communication with the sender FAX without routing a signal through the PSTN and forward the FAX communication to the sender FAX machine.

21. The apparatus of claim 20, wherein the first converter is comprised of:

a FAX transmit buffer configured to store the FAX communication received from the sender/receiver FAX via a FAX communication port, wherein the FAX communication port establishes communication with the sender/receiver FAX machine without routing a signal through the PSTN;

a FAX to network package unit configured to receive the FAX communication and convert the FAX communication to generate the FAX data packet including the sender/receiver FAX-network ID; and

a transmit channel arbitrator configured to monitor a sender/receiver side end station transmit channel, and transfer the FAX-data packet the FAX-network server via a transmit channel of a LAN communication port.

22. The apparatus of claim 21 wherein the second converter is comprised of:

a source IP extractor configured to detect the sender/receiver IP address by monitoring packets transmitted to the sender/receiver side LAN end station to generate a notification packet including the sender/receiver FAX-network ID and the sender/receiver IP address;

a transmit channel arbitrator configured to monitor a sender/receiver side end station transmit channel and transfer the notification packet to the FAX-network server via a transmit channel of a LAN communication port;

a receive channel filter configured to monitor packets transmitted to the sender/receiver side LAN end station in order to identify and intercept the FAX data packet, such that the session port number matches the predefined session port number and the source IP address matches an IP address of the FAX-network server;

a FAX receive buffer configured to store the FAX data packet; and

a network format to FAX format unpack unit configured to extract the FAX communication from the FAX data packet and forward the FAX communication to the sender/receiver FAX via a FAX communication port, such that the FAX communication port establishes the communication with the FAX machine without routing a signal through the PSTN.

23. A method of transmitting a FAX communication from a sender FAX to a receiver FAX without routing a signal through a PSTN, the method comprising steps of:

detecting a receiver IP address of a receiver side LAN end station;

generating a notification packet including the receiver IP address and a receiver FAX-network ID;

sending the notification packet to a FAX-network server;

receiving the notification packet at the FAX-network server, wherein the FAX-network server includes a mapping table between a destination FAX-network ID and a destination IP address;

establishing a communication link between a first converter and the sender FAX without routing a signal through a PSTN;

receiving the FAX communication from the sender FAX at the first converter;

generating a FAX packet by converting the FAX communication to a network packet format including the receiver FAX-network ID;

sending the FAX packet to the FAX-network server;

transmitting the FAX packet to the destination IP address looked-up in the mapping table of the FAX-network server with the receiver FAX-network ID as a key;

intercepting the FAX packet at a second converter;

extracting the FAX communication from the FAX packet;

establishing a communication link with the receiver FAX machine without routing a signal through a PSTN; and

transmitting the FAX communication to the receiver FAX.

24. The method of claim 24, wherein the step of generating includes inserting a predefined session port number into the notification packet that indicates the origin of the fax communication.

25. The method of claim 24, step of generating includes inserting a FAX network type field into the notification packet, wherein the FAX network type field identifies the FAX packet as either a FAX data packet or a notification packet.

26. The method of claim 23, wherein the detecting step further includes steps of:

intercepting a network packet transmitted by the receiver side LAN end station;

determining a source IP address in a header of the network packet; and

using the source IP address as the receiver IP address.

27. The method of claim 23, wherein the sending the notification packet step further includes steps of:

monitoring a receiver side LAN end station transmit channel;

asserting a pause control to the receiver side LAN end station;

arbitrating a LAN transmit channel for sending the notification packet;

transmitting the notification packet to the FAX-network server via the LAN transmit channel;

de-asserting the pause control to the receiver side LAN end station; and

arbitrating the LAN transmit channel to the receiver side LAN end station.

28. The method of claim 27, wherein the step of asserting pause control is performed when the transmit channel is idle.

29. The method of claim 27, wherein the FAX data packets are associated with a high priority level and the transmit channel arbitrator includes a latency control module that detects the high priority level and the step of asserting a pause control is performed when the high priority level is detected.

30. The method of claim 29, wherein the step of de-asserting the pause control is performed once the FAX-data packets associated with a high priority level have been transmitted to the FAX server via the LAN transmit channel.

31. The method of claim 23, wherein the method further includes steps of:

detecting a sender IP address of a sender side LAN end station;

generating a notification packet including the predefined session port number in a header of the notification packet, the sender IP address and a sender FAX-network ID; and

sending the notification packet to the FAX-network server,

wherein a new entry in the mapping table is created containing the sender FAX-network ID and the sender IP address, such that a FAX communication can be transmitted to the sender FAX.

32. The method of claim 23, wherein the receiving the notification packet step further includes steps of:

receiving a network packet;

determining whether the network packet is a notification packet based on an identification field in the network packet;

extracting a source IP address and a source FAX-network ID from the notification packet;

creating a new entry in the mapping table including the source FAX-network ID and the source IP address; and

repeating these steps for each sender/receiver FAX added to a FAX through data network.

33. The method of claim 23, wherein the step of establishing a communication link between a first converter and the sender FAX further includes steps of:

monitoring an on/off hook of the sender FAX machine;

generating a dial tone to the sender FAX machine;

establishing a communication channel between the sender FAX machine and a PBX emulation device;

establishing a FAX communication protocol with the sender FAX machine;

registering a destination FAX telephone number to determine whether the destination FAX phone number is a FAX-network ID;

when the destination FAX phone number is a FAX-network ID, storing the FAX communication to a FAX transmit buffer;

when the destination FAX phone number is a FAX phone number, routing the FAX communication to the destination FAX machine via the PSTN; and

disconnecting the line when the sender FAX machine is on hook.

34. The method of claim 23, wherein the sending the FAX packet step further includes steps of:

monitoring a sender side LAN end station transmit channel;

when the transmit channel is idle, asserting a pause control to the sender side LAN end station;

arbitrating a LAN transmit channel for sending the FAX packet;

transmitting the FAX packet to the FAX-network server via the LAN transmit channel;

de-asserting the pause control to the sender side LAN end station; and

arbitrating the LAN transmit channel to the sender side LAN end station.

35. The method of claim 23, wherein the transmitting the FAX packet step further includes steps of:

receiving the FAX packet at the FAX-network server;

extracting a FAX-network ID from the FAX packet;

looking-up a destination FAX IP address in the mapping table with the FAX-network ID as a key;

repackaging the FAX packet with a FAX-network server IP address as the source address of the FAX packet and the destination FAX IP address as the destination IP address of the FAX packet; and

transmitting the FAX packet to the destination FAX IP address.

36. The method of claim 23, wherein the intercepting step further includes steps of:

receiving a network packet transmitted to the receiver side LAN end station;

analyzing a session port number and a source address of the network packet;

when the source address matches the FAX-network server IP address, storing the network packet in a FAX receive buffer; and

when the source address doesn't match the FAX-network server IP address, sending the network packet to the receiver side LAN end station.

37. The method of claim 23, wherein the step of establishing a communication link with the receiver FAX further includes steps of:

generating a ring/answer request to the receiver FAX machine with a PBX emulation device;

establishing a communication channel between the receiver FAX and the PBX emulation device;

establishing a FAX communication protocol with the receiver FAX; and

retrieving the FAX communication from a FAX receive buffer.

38. A computer readable medium containing instructions which, when executed by a computer:

detect a receiver IP address of a receiver side LAN end station;

generate a notification packet including the receiver IP address and a receiver FAX-network ID;

send the notification packet to a FAX-network server;

establish a communication link between a first converter and the sender FAX without routing a signal through a PSTN;

receive the FAX communication from the sender FAX at the first converter;

generate a FAX packet by converting the FAX communication to a network packet format including the receiver FAX-network ID; and

send the FAX packet to the FAX-network server.

39. A computer readable medium containing instructions which, when executed by a computer:

receiving a FAX packet from the first converter, the FAX packet associated with a FAX-network ID indicating a destination FAX machine, the FAX packet containing a FAX communication;

using the FAX network ID as a key to find an IP address in a mapping table, the mapping table containing a FAX network ID associated with an IP address;

routing the FAX packet to the IP address over a public computer network.

40. An appliance control apparatus for asserting a control command to an appliance from a remote network user using an appliance communication protocol, the apparatus comprised of:

an appliance side LAN end station having an appliance IP address;

an appliance control packet generated by the remote network user and including an appliance network ID and the control command;

an appliance network server configured to receive the appliance control packet, extract the appliance network ID, lookup a corresponding destination IP address in a mapping table, and forward the appliance control packet to the destination IP address; and

an appliance converter configured to intercept and identify the appliance control packet, extract the control command and assert the control command to the appliance using the appliance communication protocol.

41. The apparatus of claim 40, wherein the appliance control packet includes a predefined session port number.

42. The apparatus of claim 40, wherein the appliance control packet includes an appliance network type field.

43. The apparatus of claim 40, wherein the appliance network ID is organized in a format similar to a PSTN telephone number.

44. The apparatus of claim 40, wherein the appliance converter is comprised of:

a receive channel filter configured to monitor a session port number and a source IP address of packets transmitted to the appliance side LAN end station in order to identify and intercept the appliance control packet, such that the session port number matches the predefined session port number and the source IP address matches an IP address of the appliance network server;

an appliance receive buffer configured to store the appliance control packet; and

a network format to appliance format unpack unit configured to extract the control command from the appliance control packet and forward the control command to the appliance machine via an appliance communication port, such that the appliance communication port establishes the appliance communication protocol with the appliance to assert the control command.

45. The apparatus of claim 41, wherein the appliance also generates a status report, such that the appliance converter is further comprised of:

a source IP extractor configured to detect the appliance IP address by intercepting a packet transmitted by the appliance side LAN end station to generate a notification packet including the appliance network ID and the appliance IP address;

an appliance transmit buffer configured to store the status report received from the appliance via the appliance communication port, wherein the appliance communication port establishes a communication with the appliance using the appliance communication protocol;

a appliance to network package unit configured to receive the status report and convert the status report to the network packet format to generate a status report packet with a user network ID of the remote network user;

a startup switch configured to receive the notification packet and the status report packet, such that once the notification packet is transferred to an output of the startup switch, the status report packet is transferred to the output thereafter; and

a transmit channel arbitrator configured to monitor an appliance side end station transmit channel, and transfer the notification packet/status report packet to the appliance network server via the transmit channel of the LAN communication port.

46. The apparatus of claim 45, wherein the notification packet includes a predefined session port number.

47. The apparatus of claim 42, wherein the transmit channel arbitrator is configured to transmit the notification packet/status report packet once the transmit channel is idle.

48. The apparatus of claim 42, wherein the transmit channel arbitrator includes a latency control module that monitors the transmit buffer for priority status data and upon detecting priority status data in the buffer, preempts the transmit channel and makes the transmit channel available for high priority data transmission.

49. The apparatus of claim 48, wherein the transmit channel is reserved for the duration of the high priority data transmission.

50. The apparatus of claim 40, wherein the appliance network server is comprised of:

an input filter configured to receive a network packet and identify notification packets, status report packets and appliance control packets based on an identification field of the network packet;

a first extractor configured to determined a network ID and an IP address contained in the notification packet to create a new entry in the mapping table;

a second extractor configured to determine a destination network ID from the appliance control packet;

a search engine configured to determine a destination IP address from the look-up table using the destination network ID as a key; and

a packet modifier configured to replace a destination IP address in a header of the status report/appliance control packet with the destination IP address and a source IP address in the header with an IP address of the application network server.

51. The apparatus of claim 41, wherein the appliance control apparatus further includes:

a plurality of appliance converters arranged in a daisy chain configuration between a LAN and the appliance side LAN end station, wherein a first converter is directly connected to the appliance side LAN end station and a last converter is directly connected to the LAN; and

a plurality of appliances each attached to one of the plurality of appliance converters,

wherein the interception and identification of the appliance control packet begins with the last converter and continues for each of the plurality of appliance converters until the first converter is reached, such that the plurality of converter are further configured to match the appliance network ID in the appliance control packet with a network ID of the respective appliance converter.

52. The apparatus of claim 44, wherein the destination network ID comprises digits arranged in an order from more significant digits to lesser significant digits, where the lesser significant digits represent individual devices on the daisy chain.

53. The apparatus of claim 44, wherein each of the appliance also generates a status report, such that each of the appliance converter is further comprised of:

a source IP extractor configured to detect the appliance IP address by intercepting a packet transmitted by the appliance side LAN end station to generate a notification packet including the appliance network ID and the appliance IP address;

an appliance transmit buffer configured to store the status report received from the appliance via the appliance communication port, wherein the appliance communication port establishes a communication with the appliance using the appliance communication protocol;

a appliance to network package unit configured to receive the status report and convert the status report to the network packet format to generate a status report packet with a user network ID of the remote network user;

a startup switch configured to receive the notification packet and the status report packet, such that once the notification packet is transferred to an output of the startup switch, the status report packet is transferred to the output thereafter; and

a transmit channel arbitrator configured to monitor an appliance side end station transmit channel, such that once the transmit channel is idle a LAN pause control is issued to the appliance LAN end station and the plurality of appliance converters, and the notification packet/status report packet is transferred to the appliance network server via the transmit channel of the LAN communication port.

54. The apparatus of claim 44, wherein the appliance-network server is comprised of:

an input filter configured to receive a network packet and identify notification packets, status report packets and appliance control packets;

a first extractor configured to determined a network ID and an IP address contained in the notification packet to create a new entry in the mapping table, where an ID address field of the mapping table includes duplicate appliance IP address for the daisy chain configuration appliance converters;

a second extractor configured to determine a destination appliance network ID from the appliance control packet; and

a search engine configured to determine a destination appliance IP address from the look-up table using the destination appliance network ID as a key;

a packet modifier configured to replace a destination IP address in a header of the status report/appliance control packet with an IP address the application network server.

55. A method of asserting a control command to an appliance from a remote network user using an appliance communication protocol, the method comprising steps of:

detecting an appliance IP address of an appliance side LAN end station;

generating a notification packet including the appliance IP address and an appliance network ID;

sending the notification packet to an appliance network server;

receiving the notification packet at the appliance network server, wherein the appliance network server includes a mapping table between a destination network ID and a destination IP address;

generating an appliance control packet including the appliance network ID and the control command;

sending the appliance control packet to the appliance network server;

transmitting the appliance packet to the destination IP address looked-up in the mapping table of the appliance network server with the appliance network ID as a key;

intercepting the appliance packet at an appliance converter;

extracting the control command from the appliance packet;

establishing a communication link with the appliance without routing a signal through the PSTN; and

asserting the control command to the appliance using the appliance communication protocol.

56. The method of claim 55, wherein the detecting step further includes steps of:

intercepting a network packet transmitted by the appliance side LAN end station;

determining a source IP address in a header of the network packet; and

using the source IP address as the appliance IP address.

57. The method of claim 55, wherein the sending the notification packet step further includes steps of:

monitoring an appliance side LAN end station transmit channel;

when the transmit channel is idle, asserting a pause control to the appliance side LAN end station;

arbitrating a LAN transmit channel for sending the notification packet;

transmitting the notification packet to the appliance network server via the LAN transmit channel;

de-asserting the pause control to the appliance side LAN end station; and

arbitrating the LAN transmit channel to the appliance side LAN end station.

58. The method of claim 55, wherein the receiving the notification packet step further includes steps of:

receiving a network packet;

determining whether the network packet is a notification packet based on an identification field in the network packet;

extracting a source IP address and a source appliance ID from the notification packet;

creating a new entry in the mapping table including the source appliance ID and the source IP address; and

repeating these steps for each appliance converter added to an appliance control appliance.

59. The method of claim 55, wherein the transmitting the appliance packet step further includes steps of:

receiving the appliance packet at the appliance network server;

extracting a appliance network IP from the appliance packet;

looking-up a destination appliance IP address in the mapping table with the appliance network ID as a key;

repackaging the appliance packet with an appliance network server IP address as the source address of the appliance packet and the destination appliance IP address as the destination IP address of the appliance packet; and

transmitting the appliance packet to the destination appliance IP address.

60. The method of claim 55, wherein the intercepting step further includes steps of:

receiving a network packet transmitted to the appliance side LAN end station;

analyzing a source address of the network packet;

when the source address matches the appliance server IP address, storing the network packet in an appliance receive buffer; and

when the source address doesn't match the appliance server IP address, sending the network packet to the appliance side LAN end station.

61. The method of claim 55, wherein the intercepting step further includes steps of:

receiving a network packet transmitted to the appliance side LAN end station;

analyzing a source address of the network packet; and

when the source address matches the appliance server IP address, analyzing a destination network ID of the network packet;

when the destination network ID matches a network ID of a respective appliance converter, storing the network packet in an appliance receive buffer;

otherwise, sending the network packet to a previous stage appliance converter in a daisy chain configuration; and

repeating the receiving, analyzing, analyzing, storing and sending steps until the network packet is stored in an appliance receive buffer.

62. The method of claim 55, wherein the appliance transmits a status report to the remote network user, the method further comprising steps of:

generating a user notification packet including a user network ID and a user IP address;

sending the user notification packet to an appliance network server;

receiving the user notification packet at the appliance network server and creating an entry in the mapping table including the user network ID and the user IP address;

generating an appliance status report including status information of the appliance;

sending the status report to the appliance converter;

converting the appliance status report to a network packet to generate a status report packet including the user network ID;

transmitting the status report packet to the appliance network server;

performing a lookup of the destination IP address in the mapping table of the appliance network server with the user network ID as a key;

transmitting the appliance packet to the destination IP address; and

receiving the network data packet at the remote network user for review of the appliance status report.

63. The method of claim 34, wherein the status report of the appliance is generated in response to a command control request from the remote network user.

64. The method of claim 34, wherein the status report of the appliance is automatically generated and periodically transmitted to a remote network user.